THE

ONTARIO WATER RESOURCES

COMMISSION

INFORMATION ON
WATER AVAILABILITY AND WATER USE
IN ONTARIO

Division of Water Resources

February 15, 1971

INFORMATION ON WATER AVAILABILITY AND WATER USE IN ONTARIO

INTRODUCTION

Estimates of water availability in Ontario and of the amounts of water withdrawn for various uses are presented below. The information was assembled from published reports and from records of the Division of Water Resources in response to a request from the Treasury Board. In-place uses of water, fish and wildlife preservation, and waste assimilation and dilution, require large quantities of water but the amounts have not been estimated for this report.

Although the estimated average annual runoff from Ontario was approximately 20 times the estimated 1970 withdrawal uses, the distribution of runoff and use is highly variable in time and location. Water availability and use can be compared properly only within a given region. Different uses of water consume various portions of the amounts of water withdrawn. Irrigation represents a use with a high consumptive demand. Examples are given of two areas, the Big Creek basin and the Whitson River basin, where water use approaches or exceeds the available supply at certain times of the year.

WATER AVAILABILITY

Runoff

The areal distribution of mean annual runoff for the province is shown in Figure 1 in inches per year. More detailed pictures of the distribution of mean annual runoff for southern and northern Ontario are shown in Figure 2 and Figure 3. In northern Ontario, five major river systems carry streamflows into Hudson or James Bay. The lowest intensity of runoff is found near the Manitoba border and the highest yield near the Quebec border. In southern Ontario the pattern of mean annual runoff

is more complex due principally to the effects of topography and the Great Lakes on the distribution of precipitation. The area of lowest yield is in the south west. One inch of runoff from one square mile produces 14.5 million gallons of water. One inch of runoff per year from one square mile is equivalent to a flow rate of 27.6 gallons per minute or 0.0737 cubic feet per second flowing for one year.

Estimated annual average flows from Ontario land and surface water areas are shown in Table 1. For those rivers with drainage outside the province, the estimates show only the amount of flow originating in Ontario.

Apart from the areal variation of runoff, there is great variation from season to season and from year to year. Seasonal variations of runoff for three regions in southern Ontario are shown in Figure 4. In the southwestern region (Region B) there is very little runoff during the months of July, August and September in an average year.

The locations of a few selected streamflow gauging stations are shown in Figure 5. Hydrographs of mean monthly flows for these stations are shown in Figures 6, 7 and 8. Again, great seasonal variation of runoff is apparent for some streams. The Hayes River, which is typical of drainage areas in Ontario near the Manitoba border, shows one flow peak occurring near the mid-point of the year. The English River has a somewhat earlier spring flow peak and a small secondary peak in October. The Shekak River and the Groundhog River in the eastern part of northern Ontario have high spring runoffs and a secondary peak occurring in October-November. The extensive natural storage of the Great Lakes and the effects of regulation result in a relatively stable flow and late peak for the St. Lawrence River at Cornwall.

Storage of the Great Lakes

The surface area, drainage area and storage of each of the Great Lakes is shown in Table 2. The percentage of the surface area in Ontario is shown for each lake; this gives a rough indication of the amount of storage within this province.

Ground Water

Ground water is available in varying amounts throughout most of the province. This ground water ultimately flows to the streams and rivers and the amount of ground-water flow is included in the runoff estimates. It is often convenient to tap ground-water reservoirs in preference to taking water from rivers and streams.

WATER USE

Withdrawal Uses

The estimated major withdrawal uses of water from ground-water and surface-water sources in the province in 1970 are developed from the estimates detailed in a 1967 paper "Adequacy of Ontario's Water Resources" by Mr. A. K. Watt, with provision for increased water demand resulting from population growth in the interim period.

Private water-supply systems are commonly utilized throughout rural parts of the province. At an average daily demand of 50 gallons per rural resident, about 100 million gallons per day are required for private and domestic purposes. It is expected that this demand will remain relatively constant in view of the moderate rural growth.

Water is required in large quantities for the irrigation of tobacco and sod farms, golf courses and cash crops. It is estimated that about 2.2 billion gallons per day are required at present and that the demand will substantially increase in future. Irrigation is needed about 20 days during a summer period.

With a population growth in the province of about ten per cent since 1966, much of which has occurred in the urban areas, the demand for public water supplies is expected to steadily increase. In municipalities with considerable industrial water demand, the per capita consumption may be in the order of 200 gallons daily. It is estimated that daily urban water requirement at present is about one billion gallons.

Industrial water uses, excluding water used in the generation of electricity, have been estimated to be about five times greater than the usage of municipally-supplied water. On this basis, the present industrial use of water would amount to about five billion gallons per day. In addition, about three billion gallons are presently required for cooling purposes at thermal power generating plants.

A summary of the estimated withdrawal water uses in Ontario during 1970 is tabulated as follows:

	Billion Gallons Per Day	Cubic Feet Per Second
Private Domestic	0.1	200
Irrigation	0.1	200
Public Supply	1.0	1800
Industrial	5.0	9300
Cooling	3.0	5600
	9.2	17,100

In-Place Uses

In addition to the present and projected quantities of water required for withdrawal uses, there are considerable amounts of water which must be available for what are referred to as in-place uses. The water requirements for such uses as waste assimilation and hydro-electric power generation are quantifiable and an important consideration in the overall allotment of a basin's resource, but there are equally important requirements for such aesthetic and environmental concerns as recreational use, and aquatic and wildlife propagation.

WATER MANAGEMENT

In relating the available supply of water to the existing and projected demands for water in the province as a whole, it would appear that the resource is more than adequate. However, it was recognized several years ago that while the water resources of Ontario are abundant and renewable, the supply of water available for use in many areas is limited. Ontario's agricultural, industrial and residential growth, with the associated increase in water use, has intensified the competition for the available water supply in several areas. Two examples of areas in which the demand for water equals or exceeds the available supply at certain times of the year will be cited here.

In the Whitson River basin near Sudbury, industrial, irrigation and sewage dilution requirements equal or exceed the available supply during two periods of the year (see Figure 9). Moreover, the total demand shown does not include domestic, farm and recreational uses, and indicates an arbitrarily-chosen sewage dilution ratio of only 4 to 1.

The Big Creek watershed in southwestern Ontario (Figure 10) is an example of a basin in which high demands for water have taxed the available supply. At the time of a major survey undertaken by the OWRC in 1965, there were 866 permits authorizing the withdrawal of water for irrigation. The irrigation of agricultural crops in the region generally creates a peak demand for water at a time when streamflow is at a minimum, and during the study period it was found that the withdrawal of water for irrigation greatly affected streamflow in the basin. The estimated maximum reductions in flow in Big Creek immediately below Delhi amounted to 73% of the daily flow and 63% of the seven-day flow. Interference with other uses and natural stream functions during these periods is obvious.

A combination of drought during the prime growing season and above average acreage planted to tobacco could result in even greater demands for water for irrigation.

The two cases described above are examples of areas where seasonal water shortages already exist. Moreover, there are several areas where similar problems can be expected in future if unplanned development continues.

In response to such situations, a permit program was established in 1961 to introduce reasonable control of ground and surface water in the province and to promote its efficient development and use. Under this program most takings of water in excess of 10,000 gallons in a day by means of works installed after March 29, 1961, require authorization by permit. In addition, normally exempted takings can be brought under permit if the Commission deems the taking to be interfering with public or private interests in water. As part of the permit program, complaints of interference are investigated and parties found to be interfering with other uses of water can be required to take action to alleviate the interference.

By December, 1970, there were 4842 valid permits authorizing the taking of a total of 12.4 billion gallons of water a day. (This figure includes the proposed taking of 10.2 billion gallons a day for cooling in thermal power generating plants).

In order to effectively manage the use of water in areas of competition for the available supply, it is essential to evaluate both the available supply and all existing uses of water, both under permit and exempted from permit. Consideration also must be given to the probable future demands for water. To this end, the Division of Water Resources initiated an intensified water-use program.

Present plans call for the compilation and evaluation of existing uses of water on a basin basis. Such information will be of direct value to the permit program in meeting its goals which were described previously. In addition, other divisions of the Commission and other government agencies are making increasingly frequent requests for data of this nature. The Commission's programs with respect to regional water supply, waste assimilation, and water quality criteria will need this type of water use data.

TABLE 1. - ESTIMATED RUN-OFF FROM ONTARIO LAND AND SURFACE WATER AREAS

	Area	Estimated Average Annual Discharge				
	sq.mi.	in.	cfs.	acre ft. per day	BGD	mgd per sq.mi.
A. Rivers Draining to Hudson Bay						
Moose	42,700	16	50,500	100,000	27.1	0.64
Albany	52,300	11	42,600	84,500	22.9	0.44
Attawapiskat	19,400	11	15,800	31,300	8.5	0.44
Winisk	26,000	9	17,300	34.300	9.3	0.36
Severn	39,300	8	23,200	46,000	12.5	0.32
Smaller Drainage Areas	91,642	11	75,000	148,900	40.3	0.44
Total	271,342		224,400	445,000	120.6	
B. Rivers Draining to Atlantic Ocean						
Great Lakes-Upper St.Lawrence Land Surface	87,820	12.6	82,000	162,700	44.0	0.50
Great Lakes-Water Surface	34,220	7.2	18,200	36,100	9.8	0.29
Ottawa River	19,200	16.4	23,300	46,200	12.5	0.65
Total	141,240		123,500	245,000	66.3	
C. Total for Ontario	412,582		347,900	690,000	186.9	

From "Adequacy of Ontario's Water Resources," A. K. Watt, March 1967

TABLE 2. - GREAT LAKES DATA[1]

	Surface Area		Drainage Area		Storage Capacity	
	Total sq.mi.	In Ontario sq.mi.	Total sq.mi.	In Ontario sq.mi.	cu. mi.	% of Surface Area in Ontario
Superior	31,820	11,110	80,000	43,330	2935	34.9
Michigan	22,400	0	67,860	0	1170	0
Huron	23,010	13,900	72,620	47,570	849	60.4
St. Clair	490	280	7,430	4,110	0	57
Erie	9,930	4,950	32,490	11,110	110	49.8
Ontario	7,520	3,980	34,800	15,920	393	52.9
Total	95,170	34,220	295,200	122,040	5457	

1. Data mostly from U. S. Lake Survey

One cubic mile = 919,987 million gallons
= 147,198 million cubic feet
= 3.38 million acre feet

Modified from "Adequacy of Ontario's Water Resources," A. K. Watt, March 1967

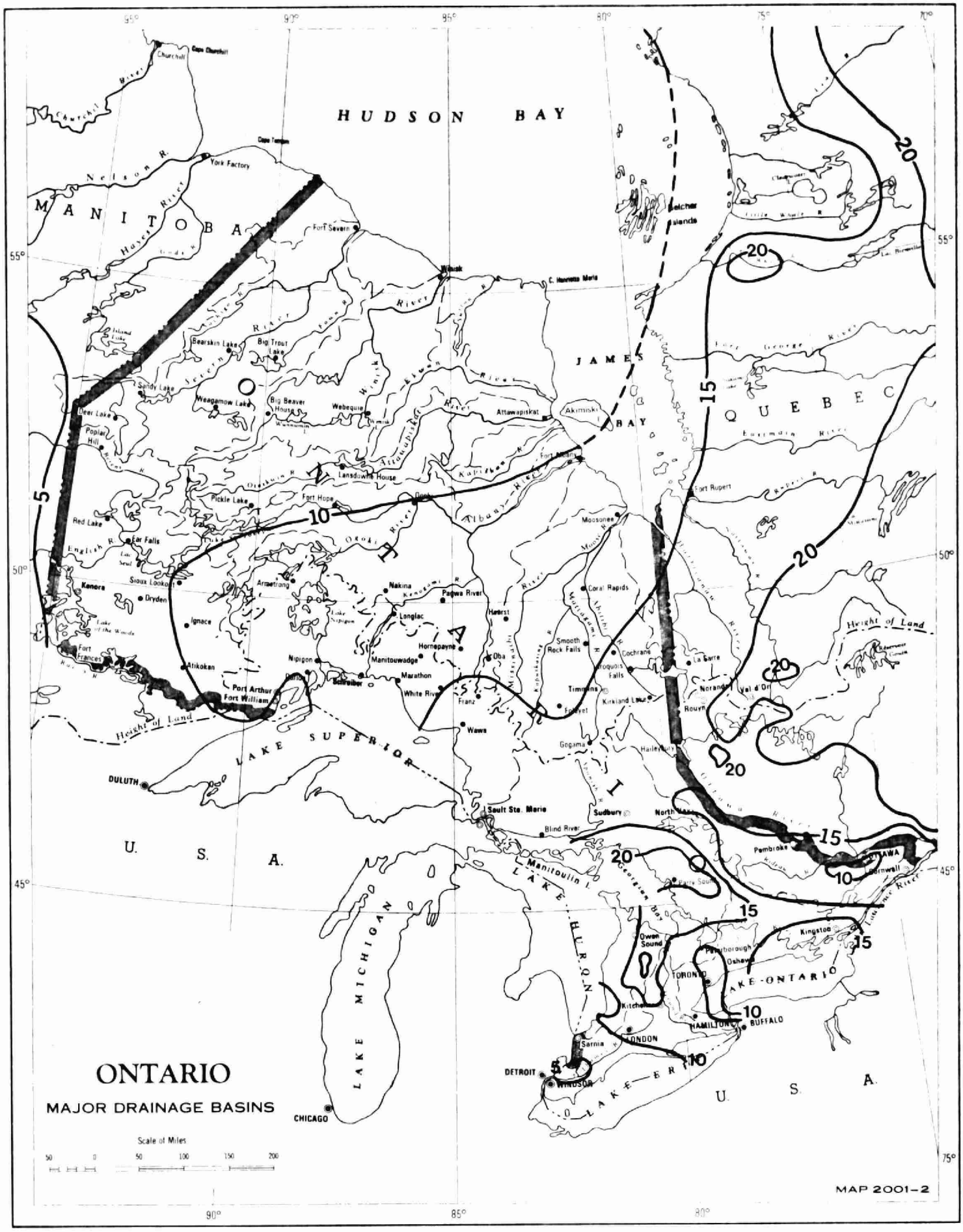


Figure 1. Mean annual runoff in Ontario, in inches per year (from the Hydrologic Atlas of Canada)

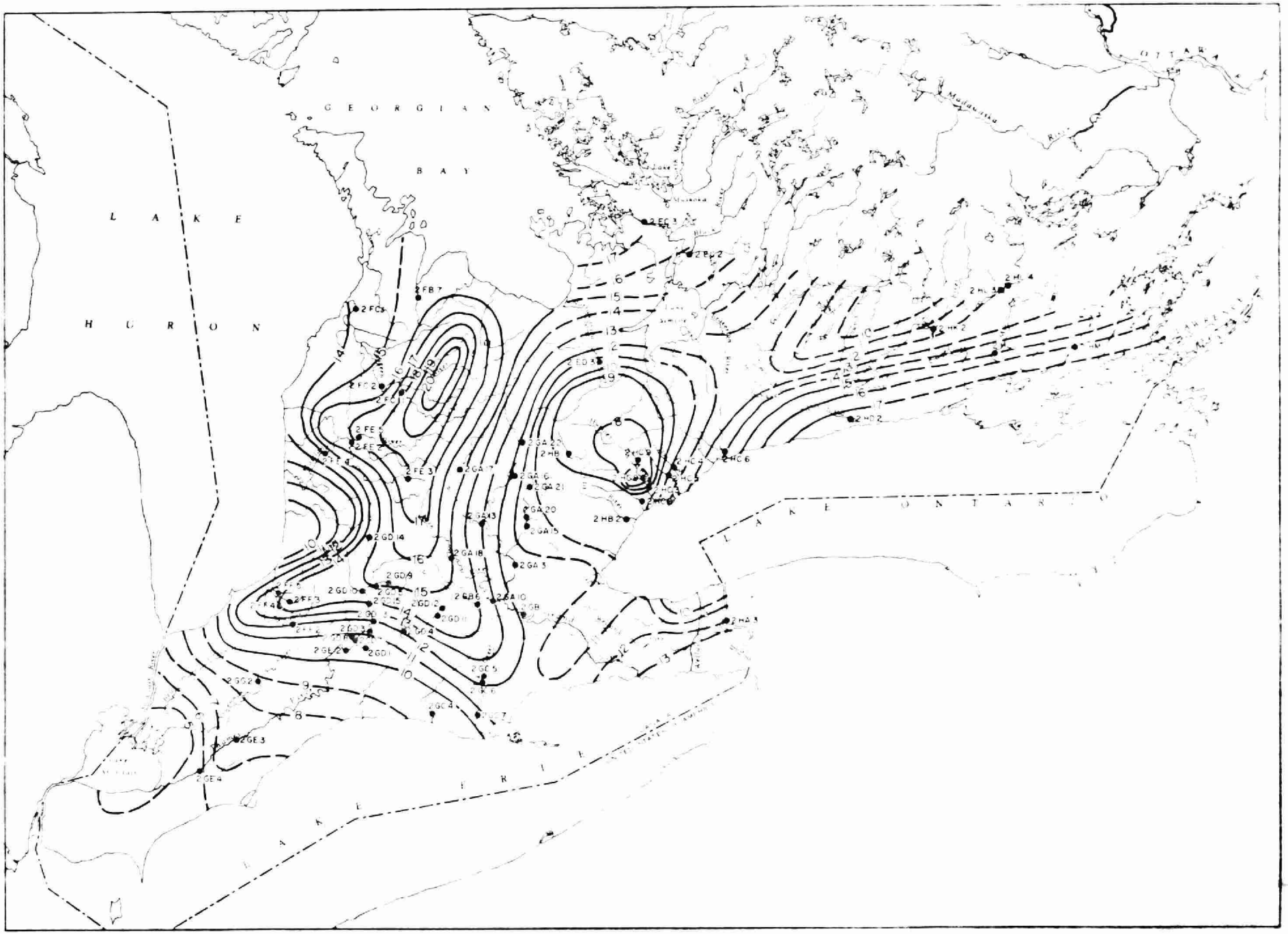


Figure 2. Mean annual runoff in southern Ontario, in inches per year (after A. Coulson, 1967)

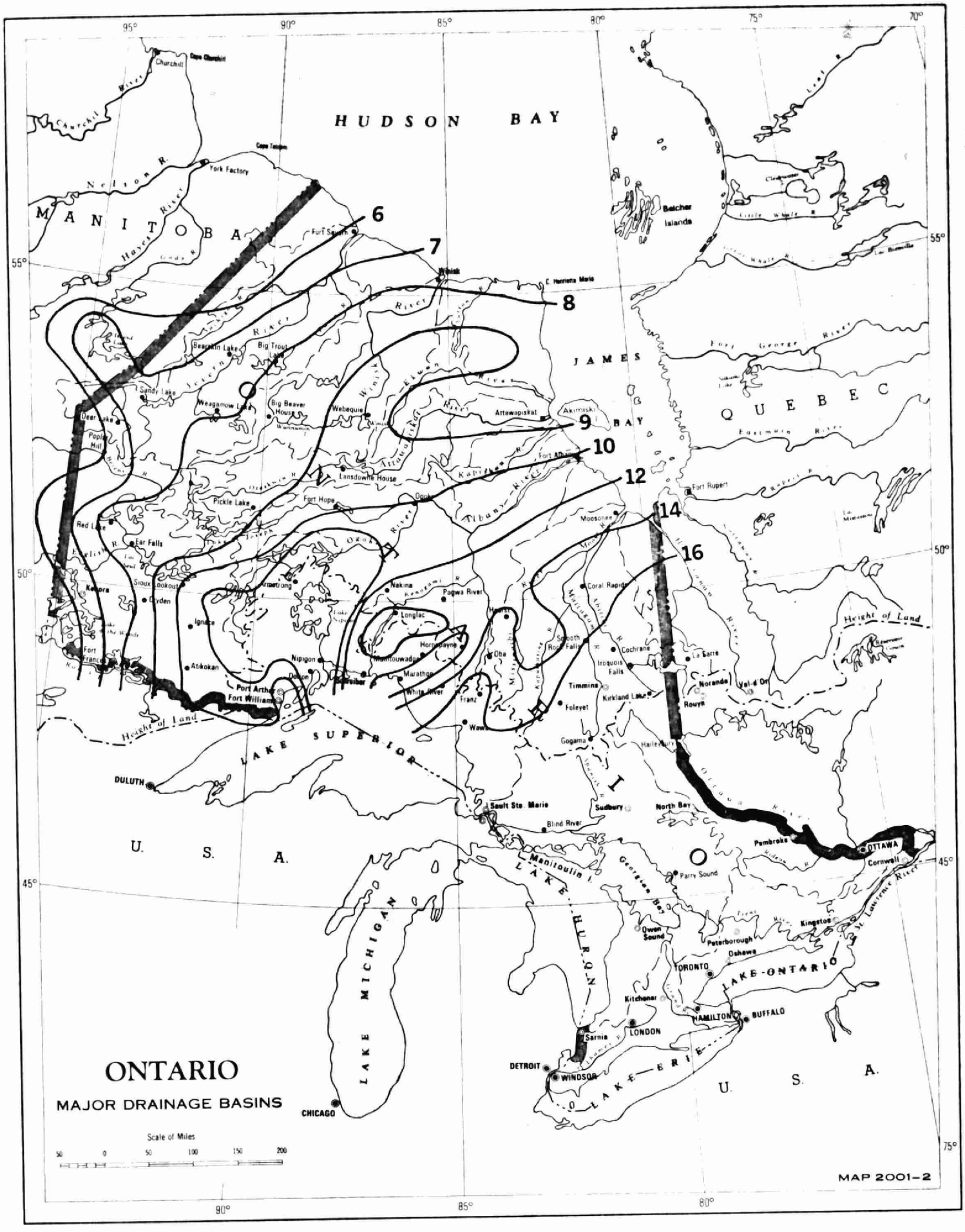


Figure 3. Mean annual runoff in northern Ontario, in inches per year (after Inland Waters Branch, Department of Fisheries and ~~Wildlife~~ Forestry)

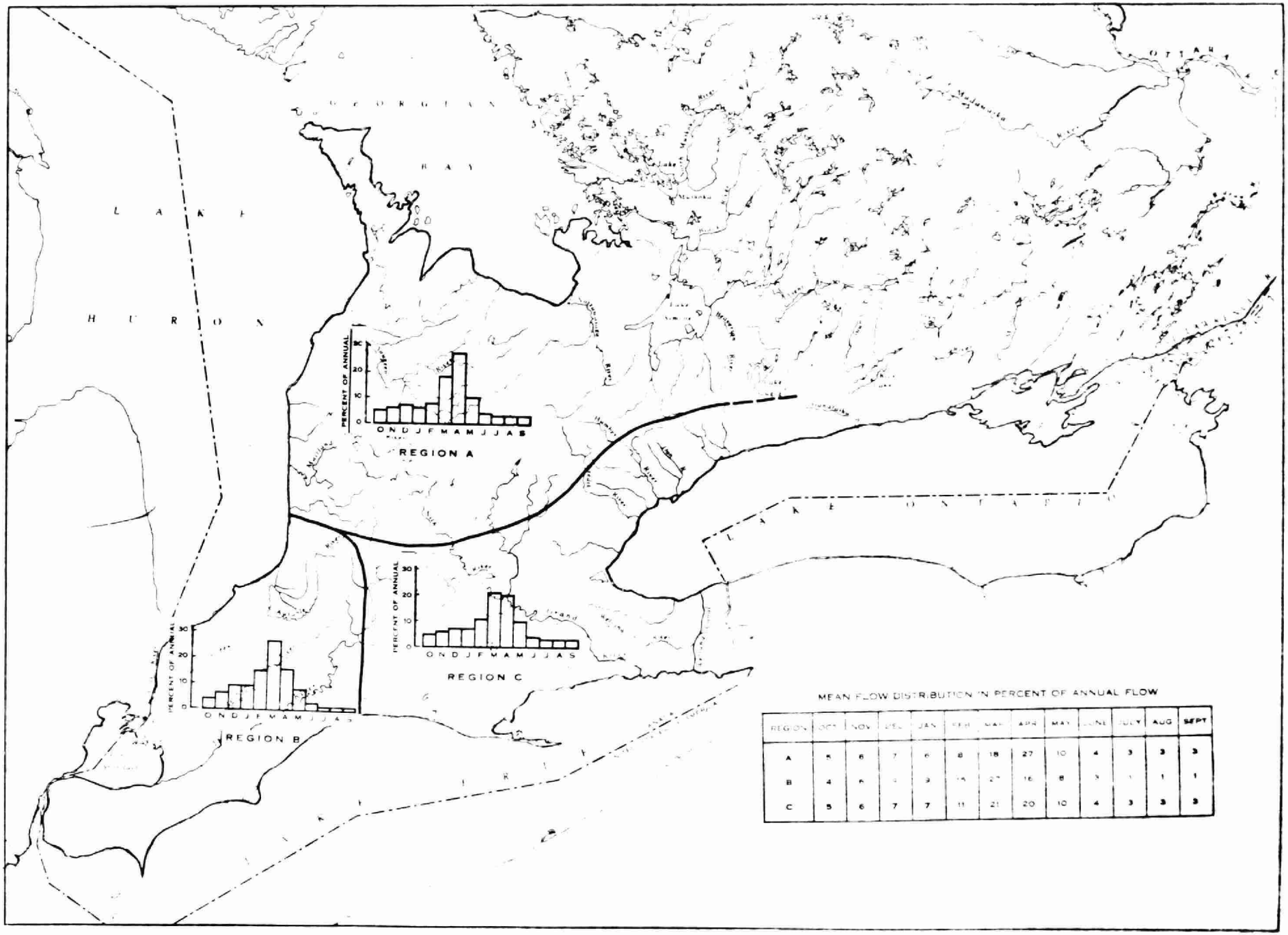


Figure 4. Mean flow distribution in southern Ontario, as a percentage of annual flow (after A. Coulson, 1967)

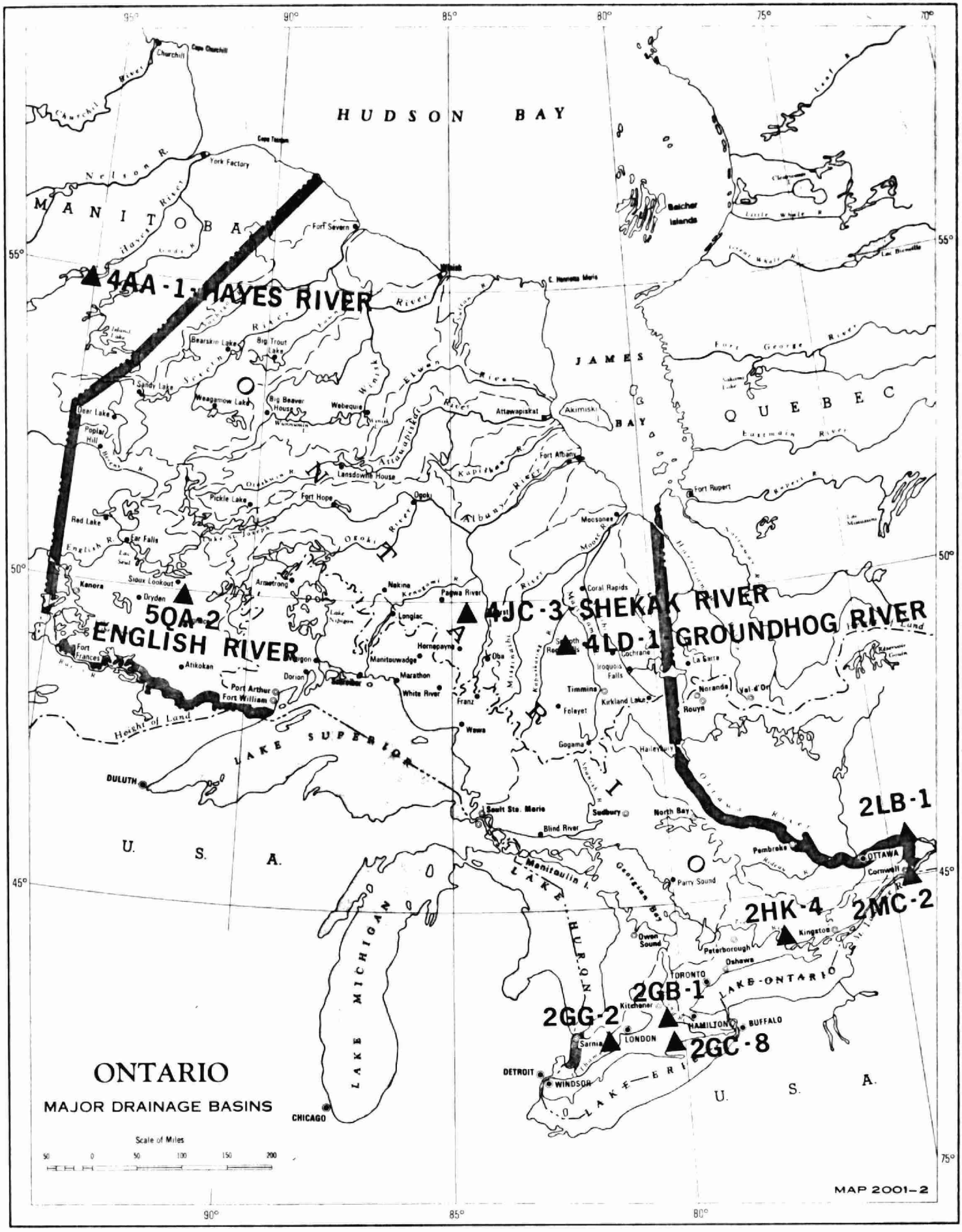


Figure 5. Locations of selected streamflow gauging stations.

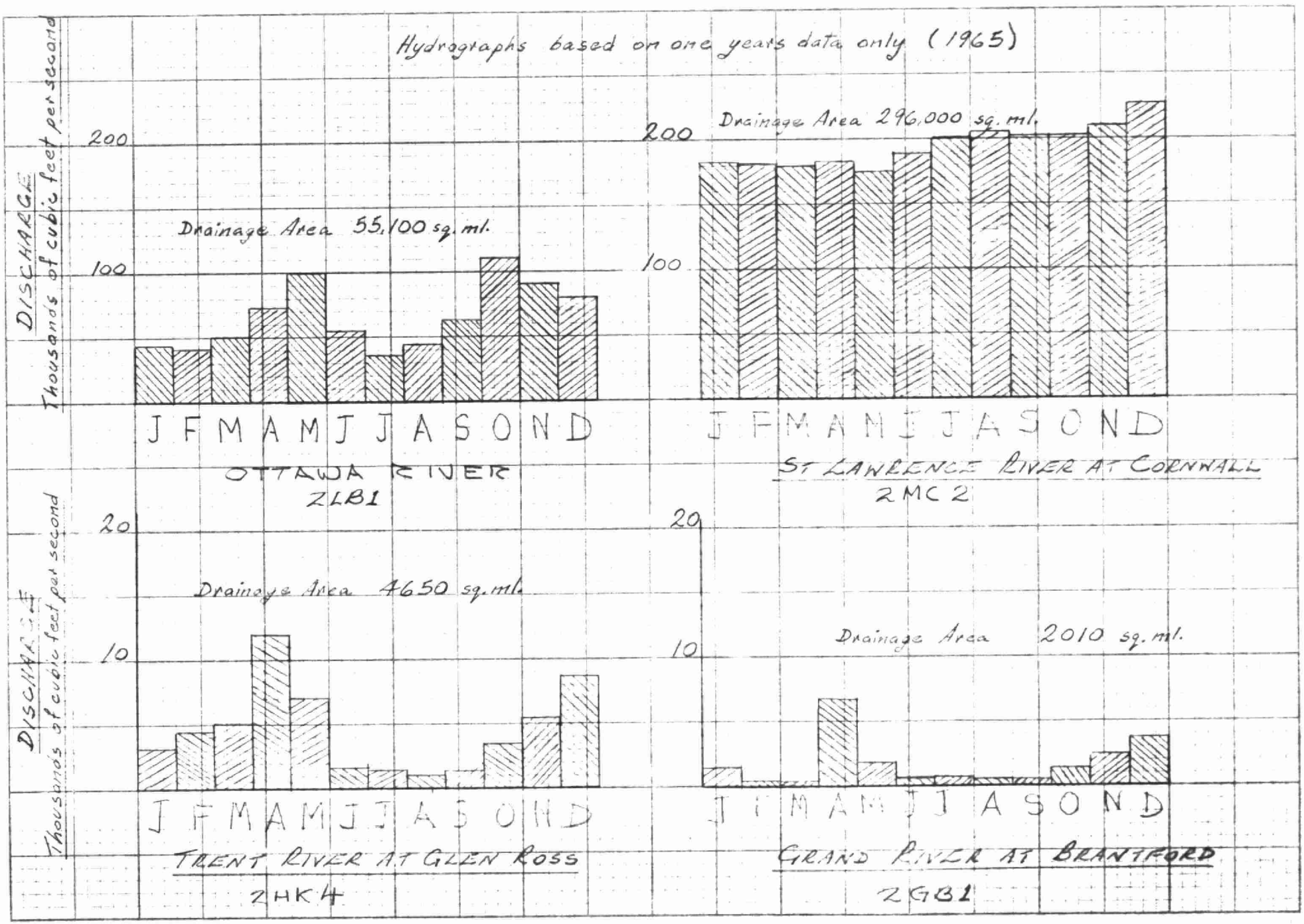


FIGURE 6. HYDROGRAPHS OF MEAN MONTHLY RUNOFF

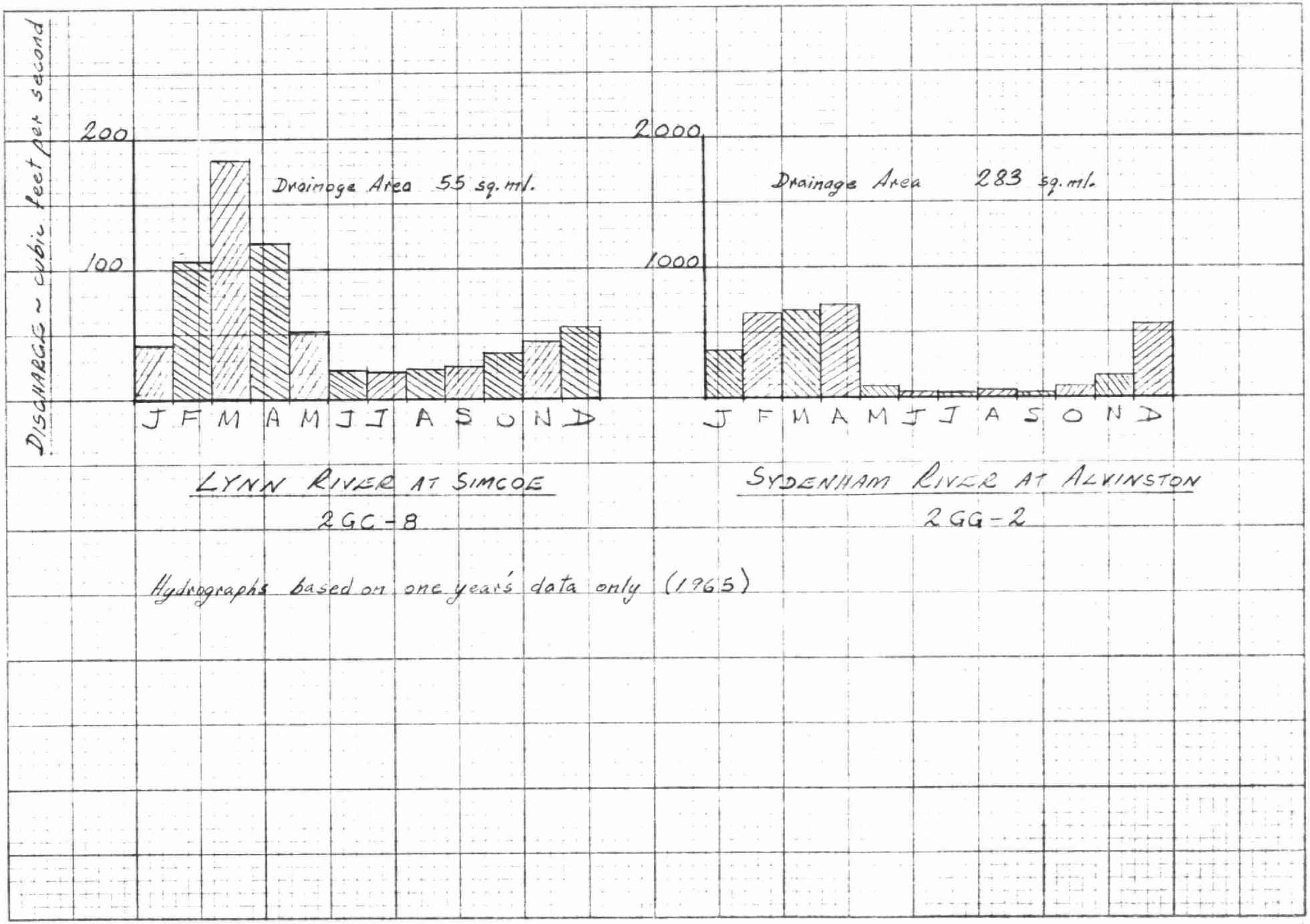


FIGURE 7. HYDROGRAPHS OF MEAN MONTHLY RUNOFF

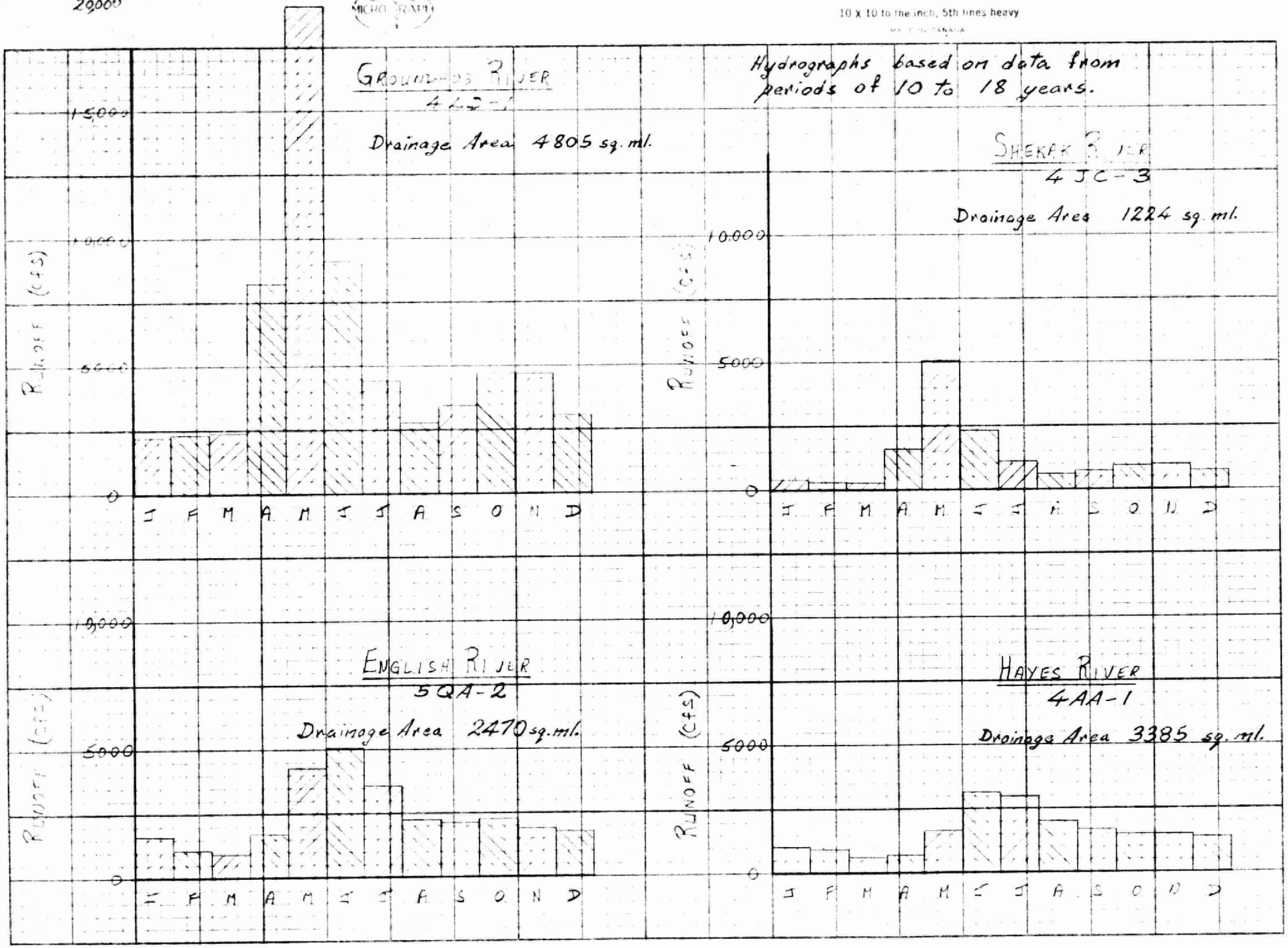


FIGURE 8. HYDROGRAPHS OF MEAN MONTHLY RUNOFF

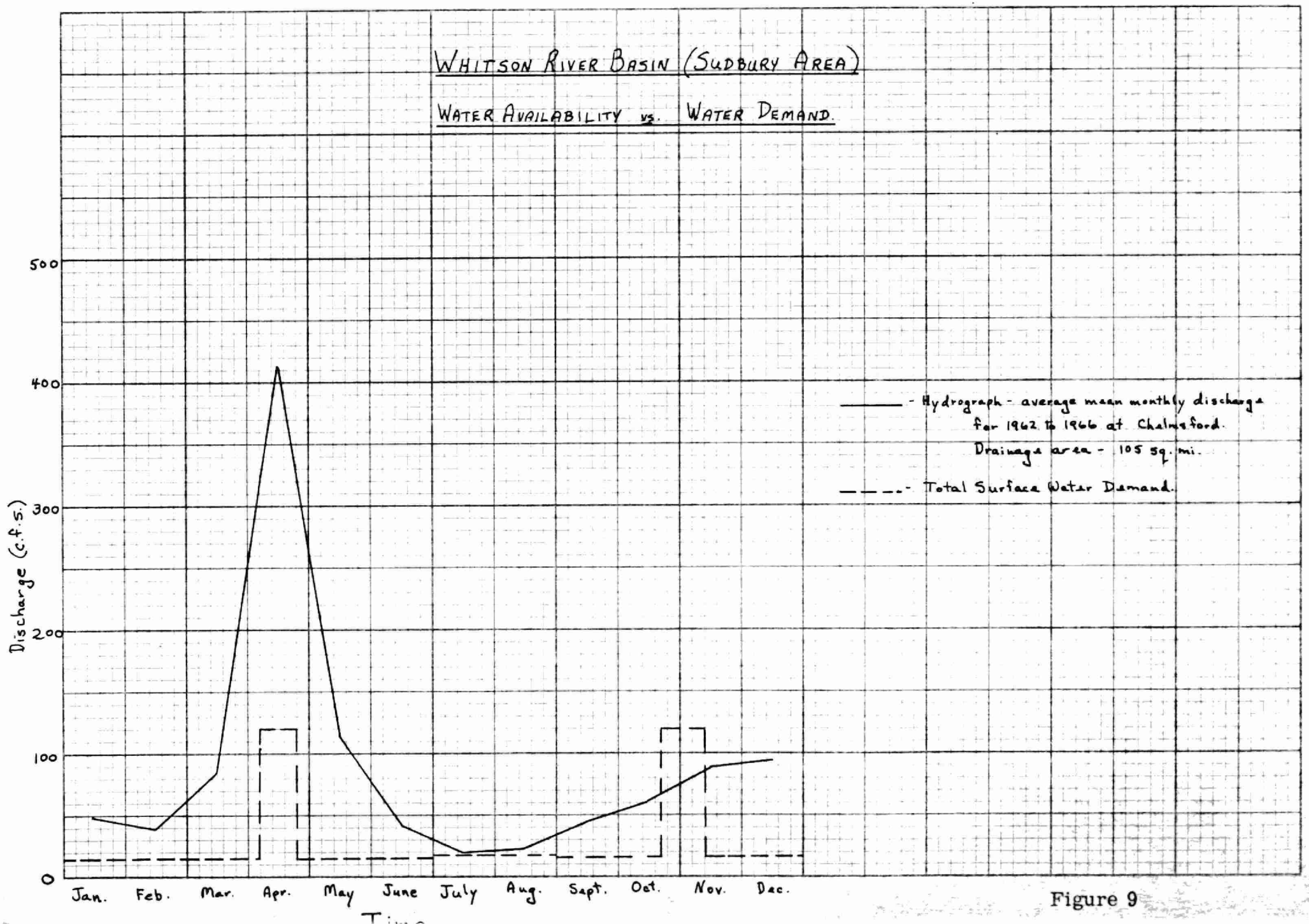
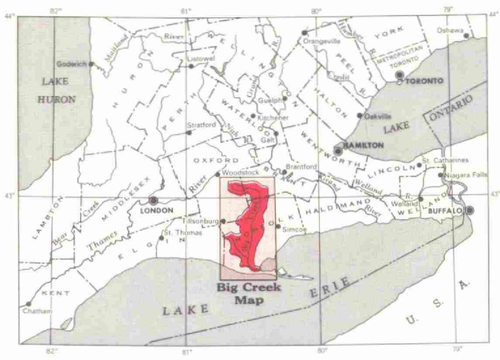


Figure 9



KEY MAP

Scale 1 inch to 50 miles

LEGEND

- Taking from stream or lake.
- Taking from well or well-point system.
- Taking from dugout.

SOURCES OF INFORMATION

Water Permit Records on file with the Ontario Water Resources Commission.

Cartography by H. A. Flotner, 1964.

Base map derived from 1:50,000 sheets of the National Topographic Series, with additional information by staff surveys, from Ontario Department of Highways maps, and from aerial photographs.

Published 1965

Universal Transverse Mercator Projection

Scale 1:100,000 or 1.58 Miles to 1 Inch

Miles

Kilometres

ONTARIO WATER RESOURCES COMMISSION

DIVISION OF WATER RESOURCES

WATER RESOURCES SURVEY

BIG CREEK DRAINAGE BASIN

SOUTHERN ONTARIO

MAP 2706-6

LOCATIONS OF WATER TAKINGS AUTHORIZED BY PERMITS

Fig. 10